

Early Stages of Old World Lepidoptera—XII¹

BY

E. P. WILTSHIRE, F.R.E.S.

(With four plates)

Previous articles in this series have mostly appeared with the title 'Early stages of Palaearctic Lepidoptera'. A few Tropical species, penetrating the Palaearctic Zone, have been described in them. My present sojourn in Bahrain (lat. 26° N.), closer to the Tropical Zone than hitherto, has led me to study a local fauna with a higher percentage of Tropical species. In fact the oasis fauna of the island (which of course must be differentiated from the desert fauna) is at least half Tropical Indian. Four or five species, therefore, described in the present article are more Tropical than Palaearctic and it seems appropriate to modify the title accordingly, though the numbering follows on after that of my previous 'Early stages' article (which appeared in October 15, 1957, *Zeits. d. Wiener. Ent. Ges.* 42, B. 68: 149-155); it falls quite naturally into that series.

As did previous articles, the present article publishes hitherto unrecorded biological and morphological details, with photographs, of the immature stages in most cases; but before proceeding to the descriptions I should like here to summarise three or four points of general interest:

i. The foodplant in the Middle East of the local races of the widespread butterfly *Junonia orithya* L. can now, for the first time, be given, and proves to belong to a botanical family not hitherto reported for this butterfly. The particular race at Bahrain is the little-known subspecies *cheesmani* Riley.

ii. In its first larval instar *Drasteria yerburyi* Butler (= *Syneda pica* Brandt, syn. nov.) has its abdominal feet much less developed

¹ For the convenience of our readers we give the references to the previous articles in the series: I 1935, *Ent. Rec.* 47; II 1936, *ibid.* 48; III 1939, *Mitt. Muench. Ent. Ges.* 29; IV 1940, *Ent. Rec.* 52; V 1944, *J. Bombay nat. Hist. Soc.* 43; VI 1946, *ibid.* 44; VII 1944, *Ent. Rec.* 56; VIII 1946, *ibid.* 58; IX 1948, *ibid.* 60; X 1952, *Bull. Soc. Fouad. I.* 36; XI 1957, *Zeits. d. Wiener. Ent. Ges.* 42.—EDS.

than in its final instar. This genus belongs to the Noctuidae-Quadrifinae, a group of subfamilies distinguished from the Trifinae by hindwing neuration and usually larval abdominal feet; some of the largest Quadrifine genera (e.g. *Catocala*, *Anua*, *Clytie*, and *Pandesma*), though not transitional in neuration to the Trifinae, have hitherto been regarded as so transitional in larval foot-structure. It is now clear that *Drasteria* must be added to this group; I note, however, from Forbes Pt. III (Memoir 329) that in some Acronyctinae (that is, Trifinae) the young larvae are 'semi-loopers' so it is doubtful whether this observation of the early instar of Quadrifinae is of taxonomic significance. It should also be noted that other Quadrifine larvae, also described in this article, namely *Thiacidas*, *Cerocala*, and *Acantholipes* do not follow *Drasteria* (and presumably *Catocala* etc.), as the degree of development of their abdominal feet does not change with larval growth; in the former, though its neuration is Quadrifine, the larva, even in its early instars, is indistinguishable from the Trifinae, having five pairs of equally developed abdominal feet; but the other two have but three pairs.

iii. *Raphia cheituna* Brandt has proved to be a synonym of the Indian species *Thiacidas postica* Walker, but, as it was not a true *Raphia*, only the subgeneric name *Tiessa* Brandt and the specific name *cheituna* need sink to Walker's names. The larvae and cocoons shed further light on the anomalous group of genera placed under Pantheinae (=Mominae), and the chaetotaxy, neuration, and genitalia are also illustrated.

iv. Rather different phenological rhythms have been observed in Bahrain from those observed further north in the Palaearctic Desert Zone; in some species (e.g. *Drasteria yerburyi* and *Cerocala sana*, both of which are desert species), a summer diapause alternates with a bivoltine, overlapping winter phenology; but in the oasis-dwelling species *Semiothisa syriacaria* there is a multivoltine overlapping summer phenology; yet despite great variation in the length of the pupal period, the moths emerged strictly at a given hour in the evening. The phenology of the oasis-dwelling *Thiacidas* also contrasts with these types.

Family NYMPHALIDAE

Junonia orithya subsp. *cheesmani* Riley (Plate I, Figs. 1, 2, 3, 4)

D. G. Sevastopulo, in 'The Early Stages of Indian Lepidoptera' Pt. VIII (*J. Bombay nat. Hist. Soc.* 42 (4), Dec. 1941, p. 748) gives some references to earlier descriptions, and redescribes the larva and

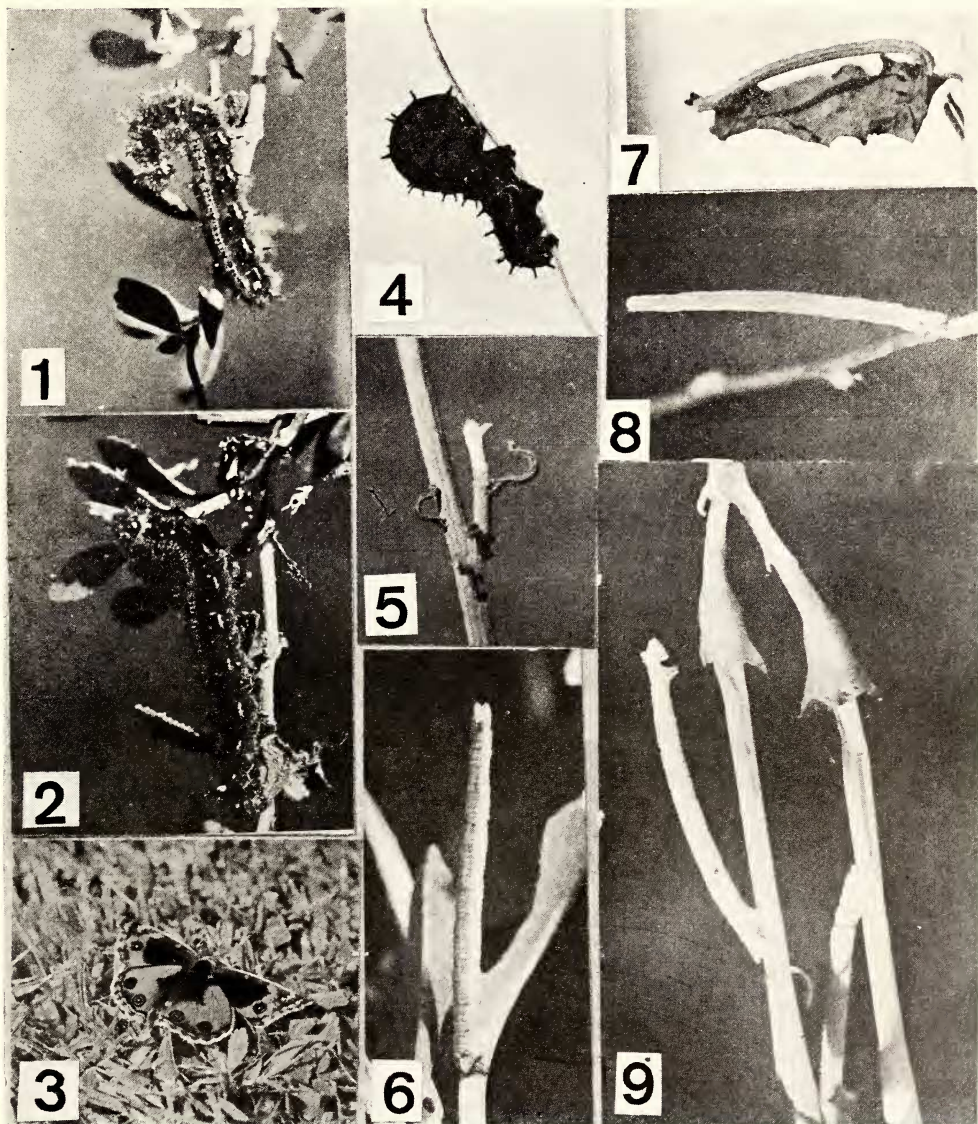
pupa of the Indian subspecies *ocyale* Hubn. The Bahrain race lacks the orange mark on the head and the orange collar there described. J. C. S. Marsh, in HONG KONG BUTTERFLIES (Hong Kong, 1960), in a very brief description of the typical race, also mentions an orange neck. The foodplant in Hong Kong would appear to be violets, while in India it is recorded as Acanthaceae. For many years I have been unable to discover what this butterfly's foodplant in the Middle East is, and my final discovery of this in Bahrain probably will be valid also for Iraq and Persia, where the race is subsp. *here* Lang.

The full-grown larva in Bahrain is velvety black dorsally, dark grey ventrally, and it is, of course, equipped with typically Nymphalid spines. The two dark areas, particularly the dorsal, are marked with many fine white points, widely spaced, and arranged in lines, the dorsal stripe is broad, suffused, yellowish white with a finer black interrupted central line. There are white lateral circumflex-marks on somites 5-9. All spines are black but the lateral and sublateral ones have brown bases. A fine white sublateral line, almost uninterrupted, runs along somites 4-10, but on somites 1-3 it is widely interrupted. The head is glossy black. The feet are brown marked with glossy black. Ventral line, smoky black.

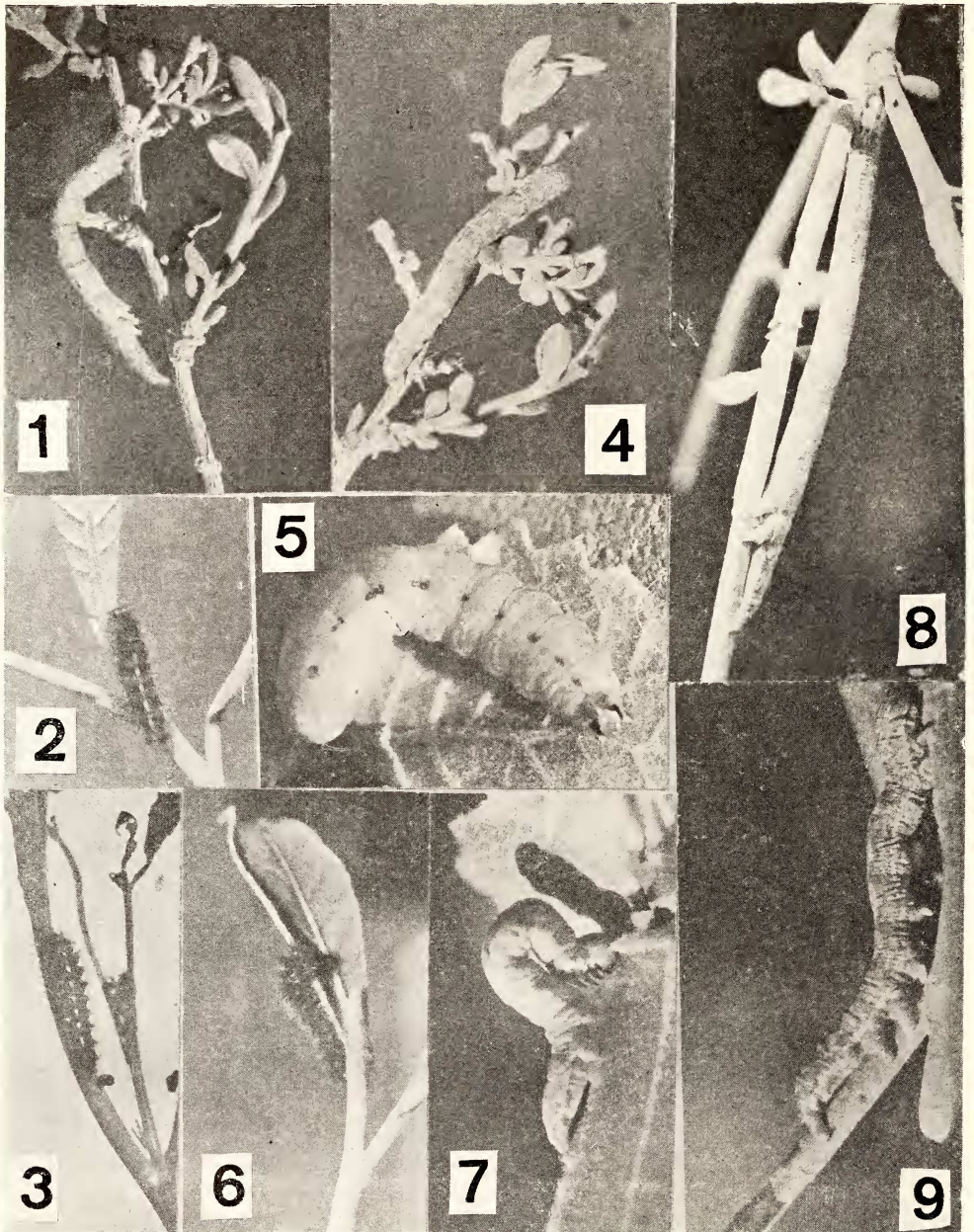
The pupa is suspended by the tail; it is inconspicuously coloured, blackish and pale whitish brown, without any metallic glint, resembling rather a fragment of wood. The figure 5a in Horsfield & Moore, 1857, Plate V, CATALOGUE OF THE LEPIDOPTEROUS INSECTS IN THE MUSEUM OF THE HON. EAST-INDIA COMPANY, 1857-9, well depicts the pupa as in Bahrain also, but Fig. 5 id. does not match the Bahrain larva. Pupal period, in March, 12 days.

Foodplant: A creeping vervain *Lippia nodiflora*. (This family of plants has not been mentioned for this butterfly before; perhaps each race is monophagous on a different plant-genus or species.) It is an obscure oasis plant but sometimes spreads on lawns and is then regarded as a pest, as it kills off the grass. In Bahrain one sees females settling on lawns not infrequently, doubtless attracted by the plant and perhaps even ovipositing. However, the larva would hardly survive on a mown lawn, and is best looked for in wet ditches in date-palm gardens, where the foodplant also grows. Fig. 3 shows a male on this foodplant on a lawn; the male exhibits the peculiar character of the Bahrain and East Arabian subspecies, the complete blue suffusion of the post-discal white band of other races.

One presumes that little migration from other parts of the Middle East, where subsp. *here* Lang flies, to Bahrain and eastern Saudi Arabia takes place, otherwise the subsp. *cheesmani* would not be distinctive,



A. *Junonia orithya cheesmani* Riley: Fig. 1, 2, 4. Larva on foodplant *Lippia*; Fig. 3. Male imago and foodplant. B. *Sterrhia mimetes* Brandt: Fig. 5. Larvae on foodplant *Taverniera*. C. *Chlorissa discessa* Walker: Fig. 6, 9. Larvae on foodplant *Clerodendron*. D. *Scopula adelpharia* Pung.: 7. Larva on foodplant *Convolvulus*. E. *Scopula ochroleucaria* H.-S.: Fig. 8. Larva.



A. *Cerocala sana* Stgr. : Fig.1, 4. Larva on foodplant *Helianthemum*. B. *Euproctis cervina* Moore: Fig. 2, 6. Larva on foodplant *Terminalia catappa*. C. *Nola harouni dilmuna* Wilts.: Fig. 3. Larva on foodplant *Trifolium*. D. *Perigea illecta* Walker: Fig. 5. Larva on foodplant *Pluchea*. E. *Mocis frugalis* F.: Fig. 7. Larva. F. *Acantholipes circumdata* Walker: Fig. 8. Larva on foodplant *Taverniera*. G. *Drasteria yerburyi* Butl. : Fig. 9. Larva on foodplant *Taverniera*.

and would lack the blue suffusion and other characters. This is strange, because the butterfly is generally migratory, and I have heard of considerable migrations of *here* in Iraq.

Family NOLIDAE

Nola harouni dilmuna Wilts., 1951 (Plate II, Fig. 3)

This subspecies was described in *J. Bombay nat. Hist. Soc.* 58 (3), and the species placed in *Celama*; however, my attention has now been drawn to the fact that *Celama* is a synonym of *Nola* (of which the typical species is *cucullatella* as pointed out by Franclemont in *Cornell Exp. Station Memoir* 371, Forbes Pt. IV, 1960), both having similarly bilobate male valves. According to that work, the genus which I have hitherto called *Roeselia* becomes *Meganola*.

The early stages of *N. harouni* now observed in Bahrain confirm its close relationship to *N. centonalis (aerugula)* as both have papilionaceous foodplants, low herbs, but the somewhat different pattern confirms the specific distinctness.

The ovum is pale grey, bun-shaped, with fine vertical sculpture; they are laid in small adhesive masses of, say, six ova.

The freshly hatched larva is yellow-grey with long black sub-dorsal hairs springing from warts; head, blackish brown.

When 11 days old, the larva is 5 mm. long, pale brown, with a yellowish or pale olive-green dorsal line edged with darker brown, wider at the anterior part of each somite. Each somite has a band of six warts, three on either side of the dorsal line; the dorsal striae thus lacks verrucae; from these warts spring short, black hairs; there are also many longer pale hairs. Head, brown. I could find no pattern of V-marks as described by English authors for *aerugula*.

One month after the ova were laid and 22-23 days after the larvae hatched, they spun cocoons; about 2 weeks later the moths emerged, making a total life cycle, in April-May, of 36-7 days. The cocoon is boat-shaped, cryptic, and in captivity is woven out of paper fragments, if paper is supplied.

Phenology: Multivoltine, perhaps with a summer diapause; I have only taken the moth from December to May, in Bahrain.

Foodplant: *Prosopis stephaniana*, and several trefoils. The moth is mainly an oasis moth, but I have taken it in certain tracts of desert, not far from gardens, and with comparatively good vegetation.

Family LYMANTRIIDAE

Euproctis cervina Moore (Plate II, Figs. 2, 6)

See my article (1961) in *J. Bombay nat. Hist. Soc.* 58 (3) for taxonomic notes on this species and its close relatives, and their distribution.

Ova, laid in piled-up masses consisting of about 100, covered with pale yellow wool from the mother's anal tuft, the second batch, laid on the second night in a different place, less well covered; green, globular. They hatch in 8 or 9 days in March, also in May.

The larvae are semi-gregarious, feeding in small groups, but readily falling off if frightened; this must tend to reduce the size of the groups and to scatter the larvae. They do not change much in appearance during growth, but naturally the markings are clearest when full grown.

The full-grown larva is a black 'woolly bear' with a fine, white, double dorsal stripe and two white dorsal spots just behind the head. Sooty-brown hair tufts stand up in a manner recalling somewhat *Syntomis* larvae. Head, small, glossy black; maxillary palps, white-marked. On somites 9 and 10 are small crimson dorsal tubercles. Abdominal feet, marked laterally with orange-brown and appearing paler than the rest of the body which is pitch black; thoracic feet, black. Spiracles, inconspicuous. Lateral stripe, pale grey. The larvae of a single batch feed at unequal rates of growth; the quickest-growing in May spun up 35 days after hatching, the slowest 59 days; The pupal period, however, is less variable; in March it is 14 days; in May it is 9 days. Pupa, glossy yellow-brown, with inconspicuous short concolorous hairs on thorax and abdomen; the cremaster is a cone, tipped with at least six short pale brown bristles. The pupa is formed in an oval, semi-transparent but blackish cocoon.

Both the ova-masses and the cocoons are hidden low down. The female moth seldom flies, is paler than the male, and has obscure habits; in fact only the male is conspicuous, and that only in the perfect stage. The male flies freely an hour before sunset and also after dark when it will come to light.

The habitat is localized; certain restricted, well-watered grassy gardens.

Foodplants: Tropical almond (*Terminalia catappa*) which is planted as a tree in these gardens, and also the undergrowth thorn *Alhagi* (Camel-thorn). The tree is more widespread than the attendant moth, and the moth's smaller habitat may well be due to the fact that, in most places in the island where the tree is planted, the garden is an

adjunct to a house, a flower garden rather than a date palm garden, and has little or no undergrowth, so that if the young larva once falls off the tree there is no alternative foodplant, and its chances of finding the tree again are small; moreover this sort of garden is full of ants, which are particularly active on *Terminalia* leaves, being attracted by their glands. These ants are, however, also carnivorous and are probably an enemy of this moth.

Mating takes place immediately after sunset. The moths remain united for a couple of hours, after which the female starts laying. The moth emerges from the cocoon late at night, between 10 p.m. and 2 a.m. There are at least three broods between March and October, and the caterpillar continues to feed throughout the winter; the moth is thus multivoltine, without diapause but they do not emerge during the cooler months.

Family NOCTUIDAE

Perigea illecta Walker (Plate II, Fig. 5)

Warren-Seitz wrongly sunk to *capensis* Gn. a number of old world Tropical species of *Perigea* (= *Propsalta*). The genus seems attached to *Pluchea* and possibly other composite fleabanes. At least the Egyptian and the Persian Gulf species, distinct from one another, both seem to have the same foodplant, which is also fed on by *Hadjina viscosa* Freyer in both countries. The Egyptian species, widespread in Africa, is *P. pauperata* Wkr. (= *Propsalta coptica* mea, syn. nov.) of which the male genitalia, with simple harpe, were illustrated in *Bull. Soc. Fouad. Ent. (Cairo)* **32**, 1948, p. 254, Fig. 35 in my list of Egyptian lepidoptera and also by Viking Nystrom in his 'Macrolepidoptera from the Cape Verde Islands', Fig. 54, (*Comm. Biol.* **17** : 7; Helsingors, 1958). Those of *P. illecta* Walker, the Indian species, which I have recently studied in Bahrain, are distinguished from those by the bifurcate harpe in the male genitalia.

The larva is bright green with yellowish somital joints, and five equally developed pairs of abdominal feet. The dorsal and sub-dorsal lines are represented by a few faint white spots. The head is marked with two black triangles, apex towards the mouth. At full maturity a widely interrupted purple dorsal line appears, leading to a white purple-rimmed spot on somite 11. The thoracic feet are black and glossy, the abdominal, brownish. The spiracles, white, black-rimmed. Before spinning up the larva turns entirely purple-brown.

Foodplant: *Pluchea (Conyza) dioscorides*.

The pupa is glossy red-brown; the abdominal somites do not taper, the tail being rounded and blunt; the cremaster consists of two straight spines. The pupal period in March-April is twelve days. The foodplant only seems to grow in Bahrain in certain well-watered gardens and consequently the moth is rather scarce and local. It is probably multivoltine.

Gardner's description of *Perigea capensis* Gn. (*Indian Forest Records* 6 : 269, 1941) disagrees completely with the larva described above but may well be some congeneric species; his following description (id.) of a different species, which he failed to name, merely referring to it as '*Perigea* sp.' appears to be identical with my *illecta* larva.

Spodoptera mauritia Boisd. (Plate III, Fig. 5)

The larva is numerous, often destructive, on lawns in Bahrain; it is widespread in the Tropics. In Bahrain it occurs together with *S. cilium* subsp. *latebrosa* Gn. which penetrates further north into the Palaearctic zone. The moth is common to light in oases, and occasionally migrates across the desert.

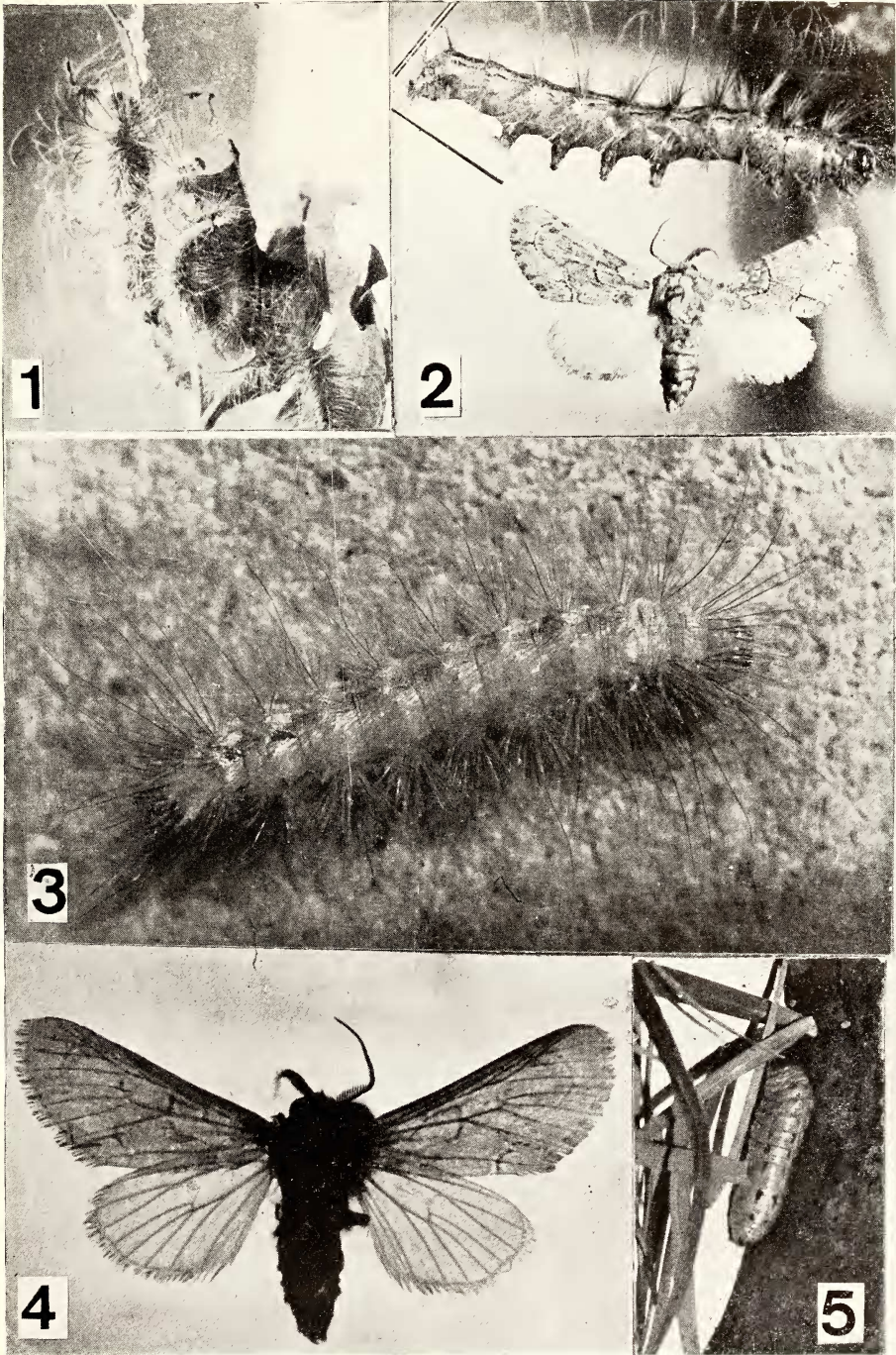
The ova are pale olive-green and are laid in neat batches in close diamond formation, one batch containing about 100 ova. They hatch after 5 days.

The freshly hatched larva is grey-green, with black head. The setae and legs are glossy black.

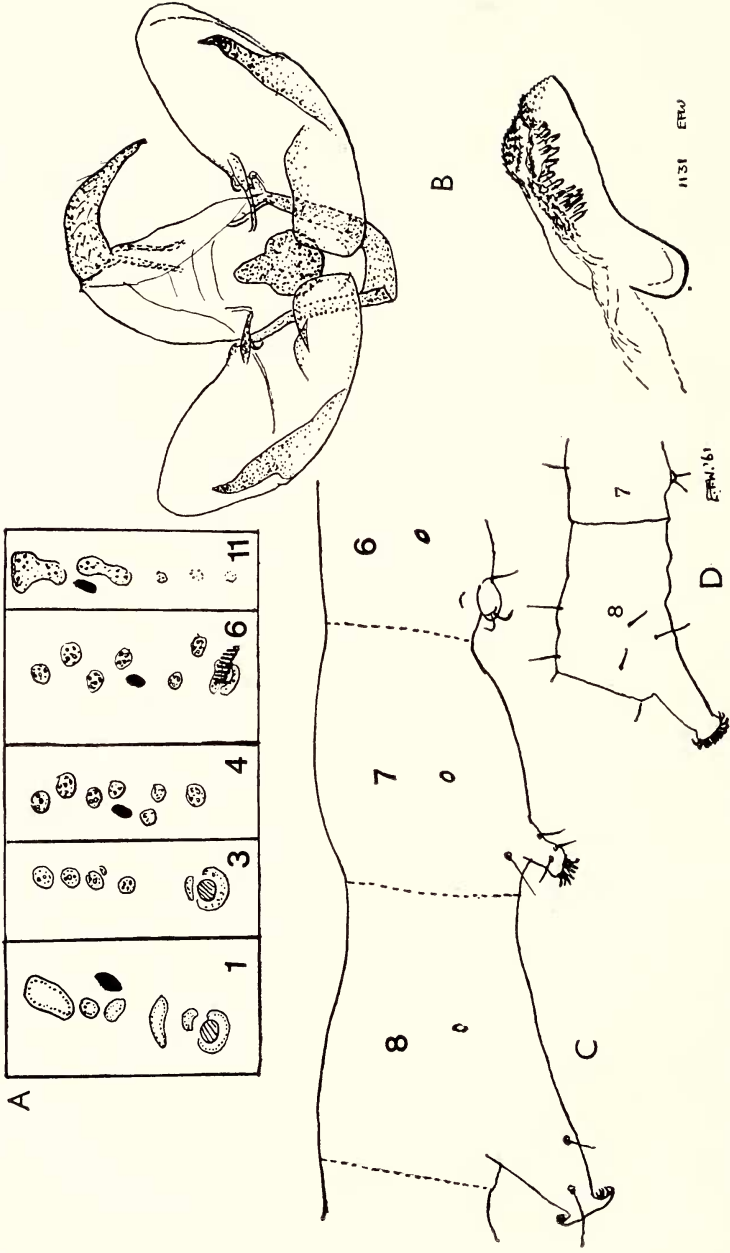
The full-grown larva is very different; it is not unlike that of *S. cilium latebrosa*, described in the preceding article in this series (1957); the character which distinguishes it from that most readily is the black marking on the sub-dorsal stripes; this is in the form of an interrupted black edge, and the black streaks are in *mauritica* broader and less circumflex-formed, being also rather irregular in form, particularly on the upper edge; moreover, the two pairs of black marks on somites 10 and 11 are roughly wedge-shaped, that on 10 tapering tailwards, that on 11 the reverse; they thus form a kind of open box mark. The thoracic somites lack black sub-dorsal markings. Thoracic and anal plates, dull brown with whitish lines. Ground colour, glossy pink, green ventrally and sublaterally. The pale sub-dorsal stripes are rather broad but not outstanding. The lateral stripe is also broad and is freckled pinkish, but its upper edge is fine, clear white, and interrupted. Spiracles pink, black-rimmed. Head, glossy brown. Setae, black, very fine.

Pupa, red-brown, glossy; cremaster, a two-pronged fork.

Pupal period, 10 days



A. *Thiacidia postica* Walker : Fig. 1. Larvae in third moult on foodplant *Zizyphus spina-christi*; Fig. 2. Larva preserved skin, lateral view, and imago, male; Fig. 3. Larvae, full grown, dorsal view; Fig. 4. Male imago, showing neurulation.
 B. *Spodoptera mauritia* Boisid. : Fig. 5. Larva and foodplant, lawn-grass.



Thiacidia postica Walker : A. larval chaetotaxy ; left side of somites 1, 3, 4, 6, and 11 ; B. Male genitalia, ventral open position with aedeagus separated. *Draxteria yerburyi* Butl. C, D, larva, abdominal feet at different stages of growth (C. somites 6, 7, and 3 of mature larva ; D. somites 7 and 8 of larva as in first three instars).

Foodplant: Grass.

When lawns are flooded (which is done twice a week, as a rule) numbers of these larvae are disturbed, and fall a prey to sparrows which gather in flocks.

Thiacidas postica Walker (= *Raphia cheituna* Brandt, syn. nov.) (Plate III, Figs. 1-4; Plate IV, Figs. A & B.)

This larva was described by J. C. M. Gardner in *Indian Forest Records* 6 (8 & 9) (1941). It is not however a Lymantriid, as was first pointed out by Dyar, 1897, *Canad. Ent.* 29 : 12; Dyar said it seemed to be a Noctuid, perhaps of the Apatelinae. However, the hindwing neuration, so clearly Quadrifid (see Fig. 4) makes it fall rather into the Pantheinae (=Momiinae) as defined by Forbes (*Lepidoptera of New York and the neighbouring States*, Pt. III, p. 290). *Raphia* Hubner is placed by him in this subfamily, and he gives details of the larvae. It is clear from this and other facts that the genus *Raphia* is attached to the tree-genus *Populus* and has an Holarctic range; the larvae are smooth and green, quite unlike those of *Thiacidas* and other Momiinae. Brandt's subgenus *Tiessa* created especially for *cheituna* is a pure synonym of *Thiacidas* Walker, which was monotypic. But *Raphia* is a good genus, of which *Thiacidas* (= *Tiessa*) cannot be considered a subgenus.

The larva is gregarious for the first three instars, and the third moult is performed gregariously; there are usually little groups of caterpillars, about six per leaf at this stage, nearly always on the same branch, doubtless all from a single egg-batch. The coloration does not change markedly during the growth of the larva. The ground colour is pale green, sometimes olive-yellow at full growth, but reverting to green in the pre-pupal diapause. Sub-dorsal lines, wavy, interrupted, yellowish green; they are heavily edged with black on somites 9 and 10, but the black edging is not connected, taking the form of two triangles, of which the base rests on the dorsal area, and the equilateral apex, pointing downwards, is rounded off by a downward wave of the sub-dorsal line; the triangular form is, however, only approximate. Below this is a darker, blue-grey, wide lateral stripe contrasting with the paler dorsal area. Long light brown hairs are arranged in bands across the centre of each somite, thickest on the back and scantiest on the sides. Long single black hairs issue laterally from these bands. A pale brown dorsal tuft on somite 10 is conspicuous. All the hairs arise from large pale brown warts. The head is glossy black with small white spots near the mouth and a large white triangular central spot in front, apex uppermost. The black-

rimmed spiracles are placed just below a pale yellow sublateral stripe edged with black below. The thoracic feet are brown; the abdominal feet are, all five pairs, equally developed, and pale green.

After the third moult (see Plate III, Fig. 1) the larvae grow too big to be more than one on a single leaf; but they usually remain near one another on a single branch till full growth. They are thus easily found by the patch of defoliation in one part of a tree, and by the droppings underneath.

Foodplant: Christ-thorn, *Zizyphus spina-christi* (Arabic: *Nebk, Sadr*).

I have only found larvae in October and November in Bahrain, though the moth flies twice a year. When full grown, the larvae leave the tree and scatter widely before pupating in some remote cranny. The cocoon is strong but thin, and composed of silk into which are woven larval hairs. Usually a long pre-pupal diapause ensues before the larva finally pupates. During this time the larva is green, naked except for a few short hairs near the head and tail, and with warts very prominent, now greenish; the black lateral markings and black head offer contrast.

One larva which spun up on November 13 produced a moth on March 25 next; but all others, and I have bred several scores, continued the pre-pupal diapause through the following summer and pupated in late September or early October, and the moths emerged about three weeks later. Some moths fly in the wild state in March-April, others in October, giving the appearance of a bivoltine phenology; but it is curious that despite search I have never found larvae in April-May.

The pupa is light brown, very glossy, with a cremaster composed of two spines, rather short and wide apart.

In Plate IV, I illustrate the larval chaetotaxy and male genitalia. The latter show affinity to *Panthauma* Stgr. and *Trissuloides* Butl. as illustrated by Kozhantsikov, FAUNA OF USSR 12. The former is not unlike the chaetotaxy of *Diphthera* Ochs., id. All these three genera were placed in the Momiinae by that author, who includes, like Forbes, *Raphia* Hubn. in the same subfamily despite the smooth larva; I agree with Forbes rather than Kozhantsikov, however, in placing this subfamily in the Noctuidae-Quadrifinae, not the Orgyidae (Lymantriidae).

Mocis frugalis F. (Plate II, Fig. 7)

J. C. M. Gardner (*Indian Forest Records* 6 : 285, 1941; and *Trans. R. Ent. Soc. Lond.* 98, pt. 4, p. 66, 1947) has described the chaetotaxy

of this larva, and some other characters from Indian material. The pupa was not described there.

The full-grown larva is pinkish yellow laterally, more greyish dorsally. The dorsal line is partly double, fine light brown, white-edged externally, the white edging in turn being dark-edged. The lateral stripes are fainter than the dorsal, and are double, brown. Spiracles, inconspicuous, black-rimmed, placed on a double brown stripe. The rather flat, rounded head is yellowish, shaded with dark grey and edged below with a white stripe on either cheek, below which five ocelli (Gardner says six) can be distinguished under magnification. Setae, fine, black, placed eccentrically on a whitish oval. Ventral stripe, fine, black, variable. Under magnification, the longitudinal striation appears as faint orange-brown lines on a milky grey ground. The spiracular stripe is creamy and contains one brown strand; it is blackish or purplish-edged below. Abdominal feet, purplish-marbled, three pairs only, equally developed; at their base, mauve or blackish pencilling forms a sublateral stripe.

Foodplant: Grass. (The photograph shows the larva on a leaf of *Pluchea*; it was in fact found on this, showing that it wanders, but it never ate any of this shrub.) It is so coloured that it would be inconspicuous amongst grass; in fact its markings are much the same as those of many grass feeders, Satyridae and Hadenidae 'Wainscots'. The latter Wainscots when alarmed fall into the grass roots and roll up into a circular spiral; *Mocis* however, being a semi-looper, falls and rolls up but not into a circle but rather into a flattened elongated ring, head to tail; at such a time the characteristic *Mocis* black marks, absent in most Wainscot larvae, appear; these are narrow black transverse bands across the back in the somital joints between somites 4, 5, and 6; these marks also sometimes appear when the larva is moving, and tensely looped, but normally are hidden. Their visual effect would be to disrupt the larva-shape and render it perhaps less recognizable.

The pupa is red-brown with a lilac bloom, purplish on the thorax, but the abdominal segments lack bloom and are darker brown. The spiracles are dark brown. The tail is blunt and rounded, the cremaster consisting of several ridges and about eight fine looped setae. There are, as in all Noctuidae, five entirely exposed abdominal somites posterior to the wing-cases. Pupal period, under two weeks. The moth is multivoltine and flies both by day and night, though in its day-flight it keeps to shady places. It inhabits the moister, grassier gardens of the Bahrain oasis, never the desert. It may be seen at most times of the year. I have received slightly larger paler forms of

this moth from south-west Arabia, and it is widespread in the Tropics of the Old World.

Before leaving the subject of this moth, I would like to add that its genitalia have been illustrated very well, but under the wrong name, by Nystrom in the same work referred to under *P. illecta* Walker above; p. 33, Fig. 92 represents *frugalis*, not *Anticarsia irrorata* F., as stated there.

Cerocala sana Stgr. (Plate II, Fig. 1, 4)

This moth inhabits warm, rather sandy deserts in the Middle East. Its early stages were quite unknown before, as also those of its congeners.

The ovum is sub-oval, yellowish nacreous, unsculptured, but with a shallow depression on one side; though it adheres slightly it seems, in captivity, to be laid at random. The ovum hatches in two weeks in November.

The young larva has three pairs of abdominal feet; the head is black, the thoracic plate brown, glossy and small; before eating, the body is yellowish grey with interrupted purplish crimson double sub-dorsal lines, of which the outer strand is thickened in the middle of each somite. When about 1 cm. long, the larva is pale grey with purplish or olive-brown stripes; the dorsal line is fine, olive-brown and slightly interrupted; the sub-dorsal stripe is double, purplish, with its upper strand slightly interrupted, its lower strand thicker and darker, broadening on each somital joint. Setae, black, very fine. Abdominal feet, grey, yellowish distally; thoracic feet, pale, yellow-tipped. Thoracic plate, pale grey, with two U-marks on either side of a central line, open forwards. Head, light brown.

In the last two instars, when about one inch long, the larva retains the above general pattern and colouring but acquires a dorsal lozenge-pattern also; the lozenges are pale, with a wider, basal part towards the posterior of each somite, and a dark, diffuse, oblique shade on each side arising from the deep purple lateral spot forms the anterior part of each lozenge.

If one preserves the larval skin by blowing, the colour fades due to the scanty pigmentation; the skin appears whitish with crimson-brown markings. From such a skin the following details were noted: anal flap, rounded, sclerotised; pale brown; the two well-developed pairs of feet on somites 8 and 9 have a glossy, chitinous, ivory-coloured skin and uniordinal brown crochets; on somites 6 and 7, instead of claspers there are simply pairs of long ventral setae not different from those on somites 4 and 5; i.e. there is no swelling, wart, or

rudimentary abdominal feet on these segments. The thoracic plate is pale brown with a darker fine brown posterior border; head, light brown, with black ocelli; all setae are inconspicuous except the ventral tactile ones.

Foodplants: *Helianthemum kahiricum* and *H. lippii*; these are two characteristic dwarf desert shrubs, leafless for much of the year, widespread on limestone desert in the south of Bahrain, and also quite widespread in Middle East deserts. The larva feeds at night, grows rather slowly. From ova laid in November larvae attain full growth in mid-March.

The moth seems to appear on the wing in the southern deserts of Bahrain regularly every year in November, whether rain has fallen by then or not; in some years I have also taken it in these localities in January, March, and April, but not all; perhaps a lack of rain inhibits further flights. In slightly more northerly localities (e.g. Ahwaz, in S. Iran, or the coast of the Lebanon, where it is confined to coastal dunes) the moth appears from its flight, in March and October, to be bivoltine, but my breeding experience now makes me doubt this. Only when a number of larvae have been successfully brought through the pupal stage in different months will the truth appear.

A curious feature of the larva's behaviour is that, if alarmed, it often drops and remains limp; sometimes, however, it will appear limp and lifeless without falling, remaining attached by the hooks of one clasper; or by the forelegs. Plate II, Fig. 1, illustrates this pose.

Drasteria yerburyi Butl. (= *Syneda pica* Brandt, syn. nov. = *Syneda albifasciata* Gaede, syn. nov.) (Plate II, Fig. 9)

This is a desert moth ranging from Somaliland, whence Gaede described it as new, to South Persia, whence Brandt did likewise. The type was taken at Aden, and it now proves to inhabit Bahrain.

Ovum, bun-shaped, unsculptured, pearly white. The period is short, but was not noted exactly.

The young larva has three pairs of abdominal feet well developed, but the pairs on somites 6 and 7 are represented by tiny papillae each bearing two setae. This is so until the third instar. In the last instar, the two anterior pairs of abdominal feet are still less developed than those on somites 8, 9 and 12, but by then have developed to an intermediate stage; the pair on somite 7 are equipped with crochets, while the pair on somite 6 has no crochets, but still consists of papillae with two apical setae, and also a few setae at its base. I have confirmed this by observations in two successive years, the first with larvae bred ex ovo, the second with larvae bred to imagines, all being examined microscopically (see Plate IV, C & D).

In colouring the larva is at first greenish, later pinkish grey; the skin is ridged transversely; spiracles, oval, yellow-brown, black-rimmed. Under magnification the pattern consists of white longitudinal lines pencilled with mauve-grey. Underside of head, marked heavily with black; upperside of head, marked with white stripes continuing from the body's sub-dorsal, lateral and sublateral stripes, and clearer than those. The five ocelli are arranged in a sickle-like row; the uppermost three are brown, the lower two and endmost of the row are black. In the last instar, when over 3 mm. long, the larva's linear markings are more distinct, consisting of a pale grey dorsal stripe containing darker grey transverse bands towards the posterior edge of the somites, divided by the dorsal line and adjacent to paler sub-dorsal stripes resembling the dorsal but with more diffuse central line; lateral stripes, more olive-grey than the dorsal; subspiracular stripe, pale grey, continuous on somites 1-7, thereafter interrupted and wavier. Ventral surface, dappled olive-grey.

Foodplant: *Taverniera spartea*, a pink-flowered desert-broom characterised by blue-green stems and small scanty oval leaves; the larva is monophagous on this, and eats, not the flowers or leaves, but the green rind of the stem. The photograph shows a part of the stem thus eaten, behind the larva. It feeds at night, and hides in the soil by day, at least when large.

Pupa, in a weak flimsy cocoon hardly worthy of the name, below the surface of the soil; red-brown, the cremaster being a blunt sclerotised tongue-like projection with two terminal spines. Pupal period in February, March, 30-40 days. Pupae, formed later, died but probably over-summer. The moth flies between October and April, and larvae of different sizes may be found during the cooler season while the moth still flies. There would thus appear to be two generations linked by a spread emergence of the first brood; the whole life cycle is interrupted by a strong diapause during the very hot summer months but it has not been observed in what stage this takes place.

***Acantholipes circumdata* Walker (Plate II, Fig. 8)**

This moth is widespread in India and also inhabits South Persia; in Bahrain it is rather rare, inhabiting deserts together with the preceding moth, *D. yerburyi*, which is commoner here, but more truly eremic.

The larva has only three pairs of abdominal feet, even when full grown, and no traces of rudimentary feet on somites 6 and 7. It is grey, slender, tapering, with a fine, paler, double dorsal line clearest on the somital joints; the other markings are intricate but weakly defined; the head is flattened, the hindmost feet or claspers are

stretched backwards and complete the spindle-formed stream-lined silhouette; the larva is thus only easy to see when moving.

Foodplant: *Taverniera spartea*, at night. It is smaller and less common than the larva of the preceding species but, like it, eats only the green rind of the plant stem. It may well feed on some other papilionaceous shrub in India and elsewhere in its range, and in that case probably does not confine itself to the rind; this diet characterises lepidopterous larvae on *Taverniera* of which, doubtless, the rind is the most nutritious and permanent available pabulum.

Pupa, very slender and tapering; the thorax and wing-cases are dull green until the end of the pupal period, the abdomen yellow-brown, terminating in a blunt short cylinder without hooks or true cremaster. The pupa-case, after emergence, is light yellow-brown all over. The pupal period is about two weeks.

I have only observed two vernal generations of this moth but presume that its phenology resembles that of *D. yerburyi*, above.

Acrobyla kneuckeri Rebel

This is a widespread Saharan-Sindian moth, its largest and darkest form having been described under the name *ariefera* Hamps., inhabiting the deserts around Karachi; it extends westward across Arabia and North Africa.

The ovum is glossy yellow, bun-shaped, and very faintly sculptured. It hatches after 9-10 days. The young larva has only three pairs of abdominal feet, but has bristly setae representing the pairs on somites 6 and 7; the whole larva appears bristly at this stage owing to the prominent grey setae on every somite, springing from wide black hoops or bands. Its general appearance is of a black and grey banded, bristly semi-looper. It proved impossible to breed further, rejecting all kinds of foodplant offered.

The moth is bivoltine, flying in March and November. It is very local in Bahrain, doubtless because its foodplant is localized; as I have only taken it at the Acacietum near Sakhir, it seems very likely that *Acacia arabica* is its foodplant; however there are one or two other herbs characteristic of this peculiar habitat, namely *Lithospermum* and *Heliotropium tuberosum*; the larva refused all of these, so its life-history is a mystery. It is mostly found elsewhere in rather southerly deserts with *Acacia* stands.

Family GEOMETRIDAE

Chlorissa discessa Walker (Plate I, Figs. 6 & 9)

This Indian Emerald moth is found on both sides of the Persian Gulf, e.g. at Bushire and Bahrain. Its larva and pupa are generally

similar to those of *C. faustinata* Mill. in aspect but not foodplant; the latter species has been observed on *Acacia arabica* in Egypt.

The ovum of *discessa* is green, glossy, flattened, oval and minutely reticulated; it hatches after 5-6 days.

The young larva is pinkish white with pale bristles but after feeding it becomes dirty yellow-green or yellow in colour, with a pink dorsal line also sometimes visible. Slight transverse wrinkles are also to be noted, the most marked of which are the whitish somital joints. The head is rounded on top, and somite 1 has two pairs of small rounded dorsal protuberances. The setae are white and at this stage, under magnification, prove to be bifurcate, branching parallel to the body surface, recalling minute palm-trees, in silhouette. There are two pairs of abdominal feet; head and feet, whether thoracic or abdominal, yellowish or dirty yellowish green.

After two weeks (of growth in the cool season) the larva is mauve-grey, tinged with pale green at head and tail; the skin is roughened with whitish warts, the larger of which are arranged in two sub-dorsal rows, leaving a mauve-grey dorsal area irregularly dotted with smaller white specks. At this stage, a few only of these warts have the tree-like branching setae noted earlier. On the sides, similar warts are arranged in interrupted oblique short lines, between which and the sub-dorsal warts there is a lateral area similar in colour and markings to the dorsal. The head is now strongly bicornuate, and the first somite has as before two pairs of dorsal protuberances mimicking the two head points; this character is found in all the larvae of the subfamily (Hemitheinae) known to me. The head is pale dirty green, with fine white specks; on each side near the mouth two ocelli stand out, black; the thoracic and abdominal feet are still coloured as the head; the anal flap has two particularly long setae but is otherwise of normal form. The spiracles are inconspicuous. The length is now about 7 mm.

The rate of growth varies individually; some larvae when already half-grown begin to show dorsal arrow-marks.

When full grown, the larva is dull olive-grey, rather pale, peppered with white spots of various sizes, circular and wart-like; the setae are black. A purple dorsal suffusion concentrated at the somital joints in the best-marked forms resembles a series of dorsal arrows pointing forwards. The foremost pair of abdominal feet is laterally purple suffused, the final pair less so. The two hindmost pairs of thoracic feet (those on somites 2 and 3) are now purplish, peppered with white specks, while the foremost pair is lighter coloured; there is also a purplish tinge on the head tips and the tips of the dorsal protuberances

on somite 1. Each somite is divided into seven or eight rings demarcated by skin wrinkles less deep than the somital joints.

The frail cocoon is spun between leaves and in litter.

The pupa is light wood-brown, sometimes rosy-tinged, with a clear black dorsal line, and infuscated wing-cases. Under magnification the thorax appears pale orange-brown with fine black setae, a dorsal line is black on the head and somite 1 only; the wing-case is more greyish, less rosy with forewing neuration indicated in heavy black. On top of the head, close to the dorsal line, are two little eye-like knobs. The abdomen is more transparent grey, with whitish grey freckling; on the abdomen the dorsal line is black, almost continuous, and sublateral lines are considerably interrupted wider and vaguer black; the spiracles are black-rimmed, but less conspicuous than the lateral setae. The remarkable cremaster consists of a flattened tongue-like process from which issue eight hooks with curly ends, arranged laterally and symmetrically, in an elegant pattern recalling wrought iron; these hooks however are brittle.

Foodplant: Chiefly the common hedge-shrub *Clerodendrum inerme* sometimes called 'false jasmine'. The larva will however also eat, if offered, a little *Caesalpinia* and grass.

The moth's habitat is strictly oasis in Bahrain, i.e. gardens not desert. There may well be a summer diapause; in any case, in two consecutive years I obtained ova from females flying in November from which moths were bred in January and February. As I have also taken the moth on the wing in May there appear to be three generations a year. There is another Emerald moth which flies in Bahrain, namely *Microloxia herbaria*; it is smaller than *C. discessa* and inhabits certain parts of the desert.

***Sterrhia mimetes* Brandt (Plate I, Fig. 5)**

This eremic moth is found in deserts along both sides of the Persian Gulf.

The ova are laid loose and are oval, blunt at either end, with longitudinal ribbing sculptured, each rib being notched transversely, coloured a dull matt pearl, later orange.

The freshly hatched larva, under magnification, appears purplish black with two fine greenish white dorsal lines and a broad greenish lateral stripe. The head is yellow-brown, and the thoracic plate has three fine white dorsal lines. The setae are fine, sparse, frosted white.

When full grown, the larva is pinkish grey, roughened with transverse ridges; the dorsal stripe is broad, dark brown, transversely black between ridges in two places at each somital joint with a con-

tinuous fine whitish central line and a whitish sub-dorsal edging consisting of white dots, each ridge being a white dot; this edging follows a wavy course rendering the stripe now narrower, now broader. Below this sub-dorsal line is placed a series of blackish dots or streaks, widely separated. The setae are short, springing from fine white points. The sublateral stripe is whitish, broad, diffuse, and continuous, with an interrupted white lateral stripe above it; below it, is a darker purplish grey sublateral area. The spiracles are inconspicuous. The head is pale buff, and the thoracic plate similar in colour, but composed of two crenate transverse ridges, the posterior being the lesser.

In March the ovum hatches after 12-14 days and the larva is full grown a month later. The moth flies from September to November and again from February to April in both desert and oasis but mainly the former.

The foodplant has not been observed wild; this genus is often polyphagous on low herbs; in captivity I could only persuade the larvae to feed on desert herbs, which are rather hard to keep fresh; they rejected the more succulent garden herbs. Among those they ate with relish were the flowers of the Composita *Launaea nudicaulis* and the flowers of *Helianthemum lippii* and *kahiricum*. As these are available for a short season only I found that the easiest way to rear them was to give them the pink-flowered desert broom *Taverniera spartea*; of this they eat not the leaves or flowers but the green rind of the stem, as can be seen in the illustration. This desert plant is rather local and the moth also inhabits parts of the desert where it is unknown, though perhaps commonest where it grows abundantly.

***Sterrhia granulosa* Warr. & Roths.**

This eremic moth was described from the Sudan and also inhabits the eastern desert of Egypt; its characters were given by me in *Bull. Soc. Fouad. Ent. (Cairo)* 33, pp. 404-5 (1949). In Bahrain, curiously, where I also discovered it to fly, it inhabits oases and is very local. The identity of Bahrain examples has been confirmed from the female genitalia which are characteristic.

The ovum is irregularly oval in form, resembling a lemon somewhat, and whitish in colour. The ova hatch after two weeks. I failed to rear the larvae.

The moth seems to be bivoltine, flying in May, and September-October.

***Scopula adelpharia* Pung. (Plate I, Fig. 7)**

This moth, previously known from Palestine and Egypt has been found commonly in Bahrain flying together with *Scopula ochroleucaria*

H.-S. which has more denticulate fasciae. Both moths are oasis moths, inhabiting Bahrain gardens, not deserts. The larva of the latter species has already been described and is shown in the same plate (Fig. 8). It may be useful, however, if I redescribe it here, after describing the larva of *adelpharia*.

The ovum of *adelpharia* is at first whitish, later reddish; it is long-oval, sculptured with longitudinal ridges which are counter-notched. It hatches after ten days in March, after only six days in May.

The freshly hatched larva is purplish, and, like other *Scopula* larvae, assumes a coil-like pose. When more mature they are long and slender and rest extended. They are longer and thinner than *Sterrhia* larvae.

When half grown the larva is darker than that of *ochroleucaria*, but later becomes paler; the whole dorsal area at this stage is purplish black with only interrupted fine white sub-dorsal lines faintly showing; the lateral stripe is broad, pale olive-green; the sublateral and ventral areas are almost as dark as the dorsal area. Ten days later, when mature, the larva is pale green-grey with a darker grey or purplish sublateral area terminating between the pairs of abdominal feet. Under magnification, fine transverse ridges may be seen, but leave smooth areas of skin on the anterior part of each somite on the back, sides and venter; this area is interrupted by a raised sublateral ridge, identical with the sublateral stripe. The head is pale, powdery purple-grey with two white sub-dorsal lines on each lobe; on the body, the dorsal and sub-dorsal lines are paler and dark-edged for the whole length of the body, the edging of the dorsal line being the darkest. Some forms have black lateral spots just above the sublateral stripe on somites 4-8; below this stripe, on some somites, are similar black spots, but these are not placed immediately below the upper lateral spots. Dark forms have the sublateral and whole ventral areas purplish, the purple hue being most intense on the sublateral.

Foodplant: *Convolvulus*, *Prosopis stephaniana*.

The pupa is lightly chitined, yellow-brown, the eyes soon turning black; the spiracles are fine and black. It is formed in an oval, rather weakly built, cocoon among litter and leaves.

From ova laid on March 12, a first generation of moths hatched between April 30 and May 11. From these a further generation of moths was bred, hatching between mid-June and mid-July. The moth is certainly multivoltine and might probably be obtained in almost any month of the year, perhaps excluding August,